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## NOVEL SKIN LIGHTENING AGENTS, COMPOSITIONS AND METHODS

This application claims priority under 35 U.S.C. 119 from U.S. provisional application Serial No. 60/432,857, filed December 12, 2002, and incorporated by reference herein in its entirety.

### FIELD OF THE INVENTION

The invention relates to cosmetic methods of using 4-substituted resorcinol derivative compounds and cosmetic compositions including same, and more specifically, 1,3-dithiane resorcinol derivatives, as skin lightening agents.

### BACKGROUND OF THE INVENTION

Many people are concerned with the degree of pigmentation of their skin. For example, people with age spots or freckles may wish such pigmented spots to be less pronounced. Others may wish to reduce the skin darkening caused by exposure to sunlight or to lighten their natural skin color. To meet this need, many attempts have been made to develop products that reduce the pigment production in the melanocytes. However, the substances identified thus far tend to have either low efficacy or undesirable side effects, such as, for example, toxicity or skin irritation. Therefore, there is a continuing need for new skin lightening agents, with improved overall effectiveness.

Resorcinol derivatives have cosmetic skin and hair benefits. Certain resorcinol derivatives, particularly 4-substituted resorcinol derivatives, are useful in cosmetic compositions for skin lightening benefits. Resorcinol derivatives are 5 described in many publications, including Hu et al., U.S. Patent No. 6,132,740; Collington et al., PCT Patent Application WO 00/56702; Bradley et al., European Patent Application EP 1 134 207; Shinomiya et al., U.S. Patent No. 5,880,314; LaGrange et al., U.S. Patent No. 5,468,472; Hiroaki et al., Japanese Patent Application JP11-255638 A2; Torihara et al., U.S. Patent No. 4,959,393; and 10 Japanese published patent applications JP 2001-010925 and JP2000-327557. Resorcinol derivatives are known compounds and can be readily obtained by various means, including by a method wherein a saturated carboxylic acid and resorcinol are condensed in the presence of zinc chloride and the resultant condensate is reduced with zinc amalgam/hydrochloric acid (Lille, et al., Tr. Nauch- 15 Issled. Inst. Slantsev 1969, No. 18:127-134), or by a method wherein resorcinol and a corresponding alkyl alcohol are reacted in the presence of an alumina catalyst at a high temperature of from 200 to 400 ° C (British Patent No. 1,581,428). Some of these compounds can be irritating to the skin.

20 Applicants have now discovered novel 1,3-dithiane resorcinol compounds, which possess skin lightening benefits. The general chemical formulas and structures of these compounds are discussed in more detail herein below. The 1,3- dithiane resorcinols have been found to be effective and possibly less irritating to the skin, and are novel compounds, that have not been used for lightening skin.

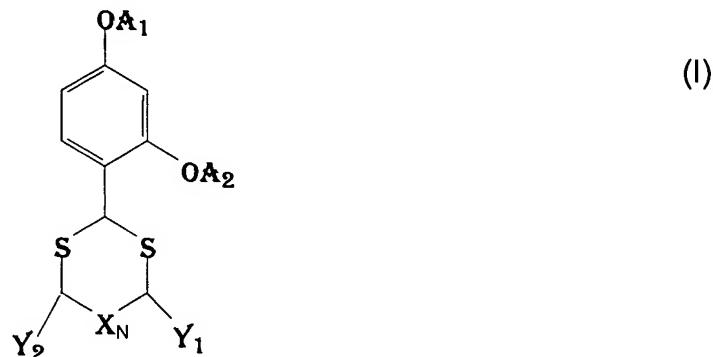
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In another aspect, the present invention relates to an inventive process for making the novel compounds of the present invention.

## SUMMARY OF THE INVENTION

Compounds of the general formula I, and compositions including same, deliver skin lightening benefits. In addition to skin lightening benefits, an additional benefit is substantially reduced irritation. The present invention provides a cosmetic composition and method of skin lightening using in addition to a cosmetically acceptable vehicle, about 0.000001 to about 50 % of a compound of general formula I,

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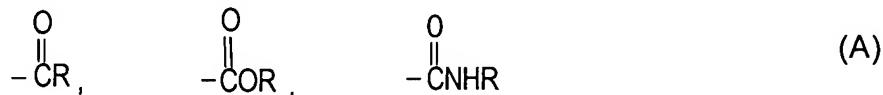


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Where:

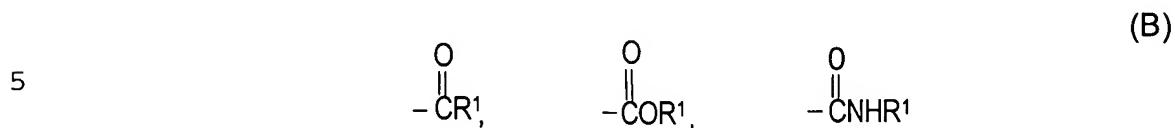
20 each  $A_1$  and/or  $A_2$  independently is = H or COR (acyl group),  $CO_2R$ ,  $CONHR$  having the following formula A:

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where R= C<sub>1</sub>-C<sub>18</sub> saturated or unsaturated, linear or branched, hydrocarbon;

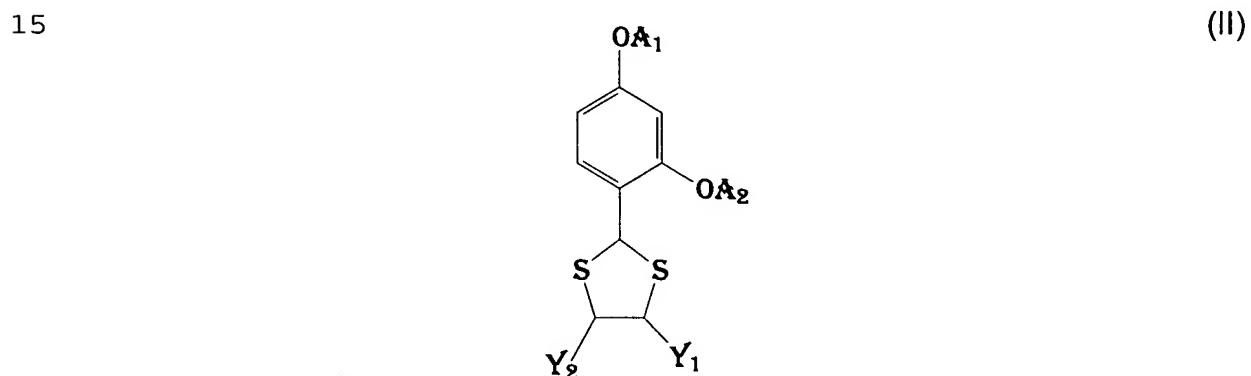
each Y<sub>1</sub> and/or Y<sub>2</sub> independently is H; C<sub>1</sub>-C<sub>18</sub> saturated or unsaturated hydrocarbon; or OZ, where Z = H or COR<sup>1</sup>, CO<sub>2</sub>R<sup>1</sup>, CONHR<sup>1</sup> of formula B:



and where R<sup>1</sup>= C<sub>1</sub>-C<sub>18</sub> saturated or unsaturated, linear or branched, hydrocarbon;

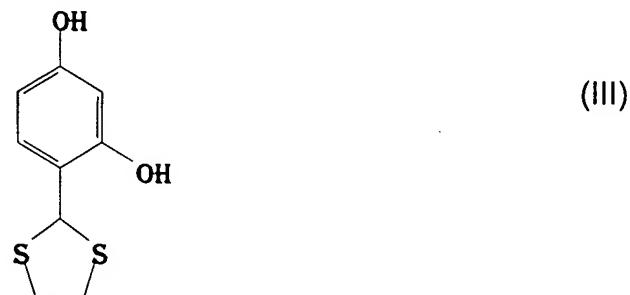
- 10 X is Carbon, Nitrogen, Sulfur, or Oxygen; preferably, Carbon; and N is in integer between 0 and 2.

When N = 0 (zero), X is disregarded, so that the dithiane structure is a 5-membered ring, and the compound has the general formula II:



In a preferred embodiment, each or both A<sub>1</sub> and/or A<sub>2</sub> represents H and  
5 each Y<sub>1</sub> and/or Y<sub>2</sub> represents H. In a more preferred embodiment, N is zero; both  
A<sub>1</sub> and A<sub>2</sub> represent H, and both Y<sub>1</sub> and Y<sub>2</sub> represent H, so that the compound is  
of formula III as follows:

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In another aspect, the present invention relates to an inventive process for making the novel compounds of the present invention. The compounds of formula III, IV and V are prepared by reacting 2,4-dihydroxy benzaldehyde with 1,2-Dimercaptoethane, 1,3-Dimercaptopropane or 1,4-dimercaptobutane,  
20 respectively, in the presence of an acid catalyst such as methane sulfonic acid, p-toluene sulfonic acid, sulfuric acid, hydrochloric acid, acidic resins and mixtures thereof. Optionally, the hydroxy groups may be further substituted by methods known in the art. For example, the one or both hydroxy groups may be esterified with any or a combination of the following acids: ferulic acid, vanillic  
25 acid, sebacic acid, azaleic acid, benzoic acid, caffeic acid, coumaric acid, salicylic acid, cysteine, cystine, lactic acid, and glycolic acid.

Further skin benefit agents may be included in the compositions useful for the inventive method. Organic and inorganic sunscreens may also be included.

The inventive compositions and methods have effective skin lightening  
5 properties, may be less irritating to the skin, and are cost-effective to prepare commercially.

#### DETAILED DESCRIPTION OF THE INVENTION

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As used herein, the term "cosmetic composition" is intended to describe compositions for topical application to human skin.

The term "skin" as used herein includes the skin on the face, neck, chest,  
15 back, arms, axilla, hands, legs, and scalp.

Except in the examples, or where otherwise explicitly indicated, all numbers in this description indicating amounts of material or conditions of reaction, physical properties of materials and/or use are to be understood as modified by the word  
20 "about". All amounts are by weight of the composition, unless otherwise specified.

It should be noted that in specifying any range of concentration, any particular upper concentration can be associated with any particular lower concentration.

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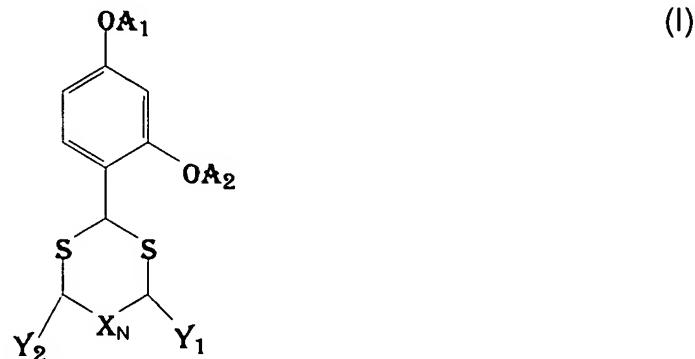
For the avoidance of doubt the word "comprising" is intended to mean including but not necessarily consisting of or composed of. In other words the listed steps or options need not be exhaustive.

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## SKIN LIGHTENING AGENTS

The invention is concerned with compounds of general formula I, shown below, compositions including same, process for making same, and use thereof as skin lightening agents. A particular advantage of the inventive compounds, 10 compositions and methods is that compounds of general formula I can be less irritating to the skin than other, known, skin lightening compounds. The present invention provides a cosmetic composition and method of skin lightening using in addition to a cosmetically acceptable vehicle, about 0.000001 to about 50 % of a compound of formula I,

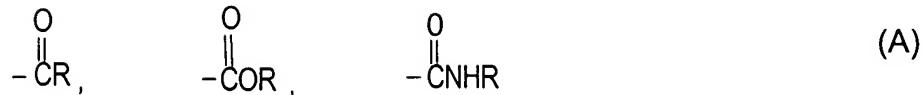
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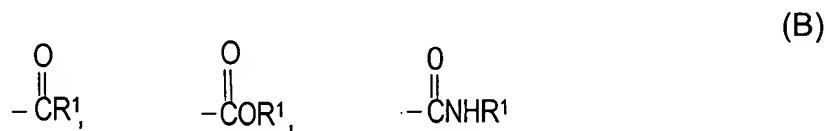
Where:

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each A<sub>1</sub> and/or A<sub>2</sub> independently is = H or COR, CO<sub>2</sub>R ,CONHR, the latter three having the following formula A:



where R= C<sub>1</sub>-C<sub>18</sub> saturated or unsaturated, linear or branched, hydrocarbon; and  
5 each Y<sub>1</sub> and/or Y<sub>2</sub> independently is H; C<sub>1</sub>-C<sub>18</sub> saturated or unsaturated hydrocarbon; or OZ, where Z = H or COR<sup>1</sup>, CO<sub>2</sub>R<sup>1</sup>, CONHR<sup>1</sup> of formula B:



10 and where R<sup>1</sup>= C<sub>1</sub>-C<sub>18</sub> saturated or unsaturated, linear or branched, hydrocarbon;

X is Carbon, Nitrogen, Sulfur, or Oxygen; preferably, Carbon; and N is in integer between 0 and 2.

15

When N = 0, X is disregarded, to that the dithiane structure is a 5-member ring, and the compound has the general formula II:



25

In a preferred embodiment, each or both A<sub>1</sub> and/or A<sub>2</sub> represents H and each Y<sub>1</sub> and/or Y<sub>2</sub> represents H. In a more preferred embodiment, both A<sub>1</sub> and A<sub>2</sub>

represent H, and both Y<sub>1</sub> and Y<sub>2</sub> represent H, so that the compound is of formula II as follows:

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20 SYNTHETIC PROCESS

Thioacetalization of 2,4-Dihydroxybenzaldehyde

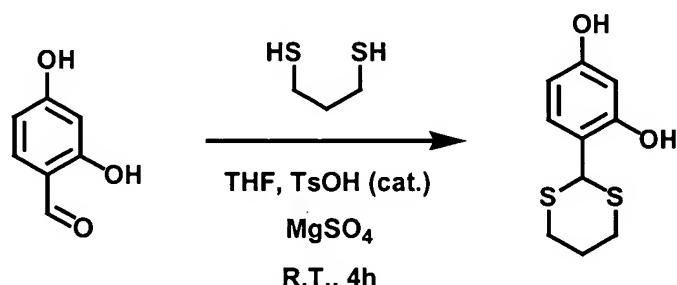
Alkyldithiol (1.2 eq) is added to a solution of 2,4-dihydroxybenzaldehyde  
25 (1.0 eq) and *p*-toluenesulfonic acid monohydrate (0.1 eq) in tetrahydrofuran (0.4-  
0.5 M solution) at room temperature under a nitrogen atmosphere. Magnesium  
sulfate (1.0 weight eq) is added and the reaction monitored by TLC until  
complete consumption of 2,4-dihydroxybenzaldehyde. The mixture is partitioned  
between ethyl acetate:saturated sodium bicarbonate, the organic layer washed

with saturated sodium chloride and the solvent removed under reduced pressure. The crude material is purified by flash chromatography to afford pure product.

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Synthesis of 4-[2'-(1',3'-dithiacyclohexyl)-1,3-dihydroxybenzene

(IV)

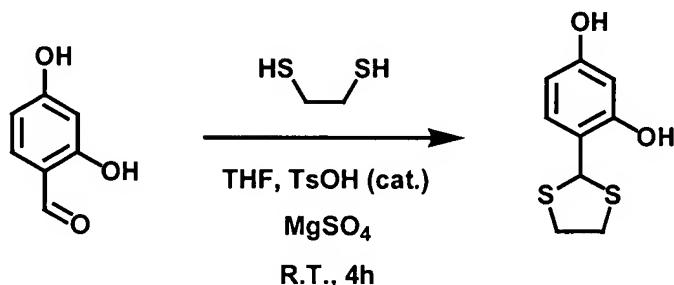


10        1,3-propanedithiol (872 uL; 8.69 mmol) was added to a solution of 2,4-dihydroxybenzaldehyde (1.0g; 7.24 mmol) and *p*-toluenesulfonic acid monohydrate (140 mg; 0.72 mmol) in tetrahydrofuran (15 ml) at room temperature (R.T. of about 20 C to about 25 C) under a nitrogen atmosphere. After 10 minutes, magnesium sulfate (1.0g) was added and the mixture stirred  
15    for 2 hours, at which point TLC (1:1 ethyl acetate:hexanes) showed the clean formation of product ( $R_f = 0.37$ ) and no starting aldehyde ( $R_f = 0.52$ ). The mixture was poured into ethyl acetate:saturated sodium bicarbonate (25ml:25ml), the organic layer washed with saturated sodium chloride (2 X 25ml) and the solvent removed under reduced pressure to give a white solid. The crude product was  
20    washed with toluene (3X 30ml) and purified by flash chromatography (silica gel;

1:1 ethyl acetate:hexanes) to give pure product as a white solid (1.35g; 95% yield).

5    Synthesis of 4-[2'-(1',3'-dithiacyclopenty)]-1,3-dihydroxybenzene

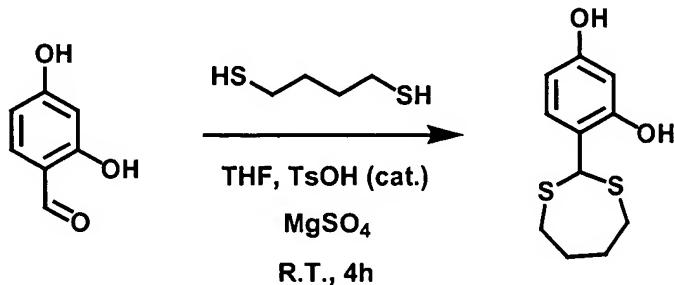
(III-A)



- 10    1,2-ethanedithiol (818 uL; 9.72 mmol) was added to a solution of 2,4-dihydroxybenzaldehyde (1.0g; 7.24 mmol) and *p*-toluenesulfonic acid monohydrate (140 mg; 0.72 mmol) in tetrahydrofuran (15 ml) at room temperature under a nitrogen atmosphere. After 20 minutes, magnesium sulfate (1.0g) was added and the mixture stirred for 4 hours, at which point TLC (1:1  
15    ethyl acetate:hexanes) showed the clean formation of product ( $R_f = 0.42$ ) and no starting aldehyde ( $R_f = 0.51$ ). The mixture was poured into ethyl acetate:saturated sodium bicarbonate (25ml:25ml), the organic layer washed with saturated sodium chloride (2 X 25ml) and the solvent removed under reduced pressure to give a yellow oil. The crude product was purified by flash  
20    chromatography (silica gel; 1:1 ethyl acetate:hexanes) to afford pure product as a faint pale yellow oil (1.40g; 90%).

Synthesis of 4-[2'-(1',3'-dithiacycloheptyl)-1,3-dihydroxybenzene

(V)



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1,4-butanedithiol (1.02mL; 8.69mmol) was added to a solution of 2,4-dihydroxybenzaldehyde (1g; 7.24mmol) and *p*-toluenesulfonic acid monohydrate (140mg; 0.72mmol) in tetrahydrofuran (15ml) at room temperature under a nitrogen atmosphere. After 10 minutes, magnesium sulfate (1g) was added and 10 the mixture stirred for 2 hours, at which point TLC (1:1 ethyl acetate:hexanes) showed the clean formation of product and no starting aldehyde. The mixture was poured into ethyl acetate:saturated sodium bicarbonate (25ml:25ml), the organic layer washed with saturated sodium chloride (2 X 25ml) and the solvent removed under reduced pressure. The crude material was purified by flash 15 chromatography (silica gel; 1:1 ethyl acetate:hexanes) to give pure product (1.57g, 90%).

COMPOSITIONS

20 The compounds of general formula I may be formulated in a cosmetic composition. The inventive compositions and methods have effective skin

lightening properties, may be less irritating to the skin than other skin lightening actives, and are relatively easy to manufacture and cost-effective.

- The compositions generally contain about 0.000001 to about 50 % of  
5 compounds of general formula I and/or II, as described hereinabove.  
Compounds of formula III are preferred. The amount of the inventive compound  
is preferably in the range of about 0.00001 % to about 10 %, more preferably  
about 0.001 to about 7 %, most preferably from 0.01 to about 5 %, of the total  
amount of a cosmetic composition.

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#### OPTIONAL SKIN BENEFIT AGENTS

- Preferred cosmetic compositions are those suitable for the application to  
human skin according to the method of the present invention, which optionally,  
15 but preferably, include a skin benefit agent in addition to a compound of general  
formula I.

- Suitable additional skin benefit agents include anti-aging, wrinkle-  
reducing, skin whitening, anti-acne, and sebum reduction agents. Examples of  
20 these include alpha-hydroxy acids, beta-hydroxy acids, polyhydroxy acids,  
hydroquinone, t-butyl hydroquinone, Vitamin C derivatives, dioic acids (e.g.,  
malonic acid, sebacic acid), retinoids, and resorcinol derivatives other than  
compound of formula I of the present invention.

COSMETICALLY ACCEPTABLE CARRIER

The cosmetically acceptable vehicle may act as a dilutant, dispersant or carrier for the skin benefit ingredients in the composition, so as to facilitate their distribution when the composition is applied to the skin.

5

The vehicle may be aqueous, anhydrous or an emulsion. Preferably, the compositions are aqueous or an emulsion, especially water-in-oil or oil-in-water emulsion, preferably oil in water emulsion. Water when present will be in amounts which may range from 5 to 99%, preferably from 20 to 70%, optimally between 40  
10 and 70% by weight.

Besides water, relatively volatile solvents may also serve as carriers within compositions of the present invention. Most preferred are monohydric C<sub>1</sub>-C<sub>3</sub> alkanols. These include ethyl alcohol, methyl alcohol and isopropyl alcohol. The  
15 amount of monohydric alkanol may range from 1 to 70%, preferably from 10 to 50%, optimally between 15 to 40% by weight.

Emollient materials may also serve as cosmetically acceptable carriers. These may be in the form of silicone oils and synthetic esters. Amounts of the  
20 emollients may range anywhere from 0.1 to 50%, preferably between 1 and 20% by weight.

Silicone oils may be divided into the volatile and non-volatile variety. The term "volatile" as used herein refers to those materials which have a measurable  
25 vapor pressure at ambient temperature. Volatile silicone oils are preferably chosen from cyclic or linear polydimethylsiloxanes containing from 3 to 9, preferably from 4 to 5, silicon atoms. Linear volatile silicone materials generally

have viscosities less than about 5 centistokes at 25°C while cyclic materials typically have viscosities of less than about 10 centistokes. Nonvolatile silicone oils useful as an emollient material include polyalkyl siloxanes, polyalkylaryl siloxanes and polyether siloxane copolymers. The essentially non-volatile polyalkyl  
5 siloxanes useful herein include, for example, polydimethyl siloxanes with viscosities of from about 5 to about 25 million centistokes at 25°C. Among the preferred non-volatile emollients useful in the present compositions are the polydimethyl siloxanes having viscosities from about 10 to about 400 centistokes at 25°C.

10

Among the ester emollients are:

- (1) Alkenyl or alkyl esters of fatty acids having 10 to 20 carbon atoms.  
Examples thereof include isoarachidyl neopentanoate, isononyl  
15 isonanonoate, oleyl myristate, oleyl stearate, and oleyl oleate.
- (2) Ether-esters such as fatty acid esters of ethoxylated fatty alcohols.
- (3) Polyhydric alcohol esters. Ethylene glycol mono and di-fatty acid esters, diethylene glycol mono- and di-fatty acid esters, polyethylene glycol (200-6000) mono- and di-fatty acid esters, propylene glycol mono- and di-fatty acid esters, polypropylene glycol 2000 monooleate, polypropylene glycol 2000 monostearate, ethoxylated propylene glycol monostearate, glyceryl mono- and di-fatty acid esters, polyglycerol poly-fatty esters, ethoxylated glyceryl mono-stearate, 1,3-butylene glycol monostearate, 1,3-butylene glycol distearate, polyoxyethylene polyol fatty acid ester, sorbitan fatty acid  
20  
25

esters, and polyoxyethylene sorbitan fatty acid esters are satisfactory polyhydric alcohol esters.

5 (4) Wax esters such as beeswax, spermaceti, myristyl myristate, stearyl stearate and arachidyl behenate.

(5) Sterol esters, of which cholesterol fatty acid esters are examples.

Fatty acids having from 10 to 30 carbon atoms may also be included as  
10 cosmetically acceptable carriers for compositions of this invention. Illustrative of this category are pelargonic, lauric, myristic, palmitic, stearic, isostearic, hydroxystearic, oleic, linoleic, ricinoleic, arachidic, behenic and erucic acids.

Humectants of the polyhydric alcohol-type may also be employed as  
15 cosmetically acceptable carriers in compositions of this invention. The humectant aids in increasing the effectiveness of the emollient, reduces scaling, stimulates removal of built-up scale and improves skin feel. Typical polyhydric alcohols include glycerol, polyalkylene glycols and more preferably alkylene polyols and their derivatives, including propylene glycol, dipropylene glycol, polypropylene glycol,  
20 polyethylene glycol and derivatives thereof, sorbitol, hydroxypropyl sorbitol, hexylene glycol, 1,3-butylene glycol, 1,2,6-hexanetriol, ethoxylated glycerol, propoxylated glycerol and mixtures thereof. For best results the humectant is preferably propylene glycol or sodium hyaluronate. The amount of humectant may range anywhere from 0.5 to 30%, preferably between 1 and 15% by weight of the  
25 composition.

Thickeners may also be utilized as part of the cosmetically acceptable carrier of compositions according to the present invention. Typical thickeners include crosslinked acrylates (e.g. Carbopol 982), hydrophobically-modified acrylates (e.g. Carbopol 1382), cellulosic derivatives and natural gums. Among useful cellulosic  
5 derivatives are sodium carboxymethylcellulose, hydroxypropyl methylcellulose, hydroxypropyl cellulose, hydroxyethyl cellulose, ethyl cellulose and hydroxymethyl cellulose. Natural gums suitable for the present invention include guar, xanthan, sclerotium, carrageenan, pectin and combinations of these gums. Amounts of the thickener may range from 0.0001 to 5%, usually from 0.001 to 1%, optimally from  
10 0.01 to 0.5% by weight.

Collectively the water, solvents, silicones, esters, fatty acids, humectants and/or thickeners will constitute the cosmetically acceptable carrier in amounts from 1 to 99.9%, preferably from 80 to 99% by weight.

15 An oil or oily material may be present, together with an emulsifier to provide either a water-in-oil emulsion or an oil-in-water emulsion, depending largely on the average hydrophilic-lipophilic balance (HLB) of the emulsifier employed.

20 Surfactants may also be present in cosmetic compositions of the present invention. Total concentration of the surfactant will range from 0.1 to 40%, preferably from 1 to 20%, optimally from 1 to 5% by weight of the composition. The surfactant may be selected from the group consisting of anionic, nonionic, cationic and amphoteric actives. Particularly preferred nonionic surfactants are those with a  
25 C<sub>10</sub>-C<sub>20</sub> fatty alcohol or acid hydrophobe condensed with from 2 to 100 moles of ethylene oxide or propylene oxide per mole of hydrophobe; C<sub>2</sub>-C<sub>10</sub> alkyl phenols condensed with from 2 to 20 moles of alkylene oxide; mono- and di- fatty acid

esters of ethylene glycol; fatty acid monoglyceride; sorbitan, mono- and di- C<sub>8</sub>-C<sub>20</sub> fatty acids; block copolymers (ethylene oxide/propylene oxide); and polyoxyethylene sorbitan as well as combinations thereof. Alkyl polyglycosides and saccharide fatty amides (e.g. methyl gluconamides) are also suitable nonionic  
5 surfactants.

Preferred anionic surfactants include soap, alkyl ether sulfate and sulfonates, alkyl sulfates and sulfonates, alkylbenzene sulfonates, alkyl and dialkyl sulfosuccinates, C<sub>8</sub>-C<sub>20</sub> acyl isethionates, acyl glutamates, C<sub>8</sub>-C<sub>20</sub> alkyl ether phosphates and combinations thereof.  
10

#### OPTIONAL COMPONENTS

15 In the cosmetic compositions of the invention, there may be added various other thickeners, calamine; pigments; antioxidants; and chelating agents; as well as sunscreens, including organic and/or inorganic sunscreens.

20 Other adjunct minor components may also be incorporated into the cosmetic compositions. These ingredients may include coloring agents, opacifiers, and perfumes. Amounts of these other adjunct minor components may range anywhere from 0.001% up to 20% by weight of the composition.

#### Sunscreens

For use as sunscreen, metal oxides may be used alone or in mixture and/or in combination with organic sunscreens. Examples of organic sunscreens include but are not limited those set forth in the table below:

TABLE 1. Typical Organic Sunscreens

	CTFA Name	Trade Name	Supplier
5	Benzophenone-3	UVINUL M-40	BASF Chemical Co.
	Benzophenone-4	UVINUL MS-40	BASF Chemical Co.
	Benzophenone-8	SPECRA-SORB UV-24	American Cyanamide
10	DEA		
	Methoxycinnamate	BERNEL HYDRO	Bernel Chemical
	Ethyl dihydroxypropyl-PABA	AMERSCREEN P	Amerchol Corp.
	Glyceryl PABA	NIPA G.M.P.A.	Nipa Labs.
	Homosalate	KEMESTER HMS	Hunko Chemical
15	Methyl anthranilate	SUNAROME UVA	Felton Worldwide
	Octocrylene	UVINUL N-539	BASF Chemical Co.
	Octyl dimethyl PABA	AMERSCOL	Amerchol Corp.
	Octyl methoxycinnamate	PARSOL MCX	Bernel Chemical
	Octyl salicylate	SUNAROME WMO	Felton Worldwide
20	PABA	PABA	National Starch
	2-Phenylbenzimidazole-5-sulphonic acid	EUSOLEX 232	EM Industries
	TEA salicylate	SUNAROME W	Felton Worldwide
	3-(4-methylbenzylidene)-camphor	EUSOLEX 6300	EM Industries
25	Benzophenone-1	UVINUL 400	BASF Chemical Co.
	Benzophenone-2	UVINUL D-50	BASF Chemical Co.
	Benzophenone-6	UVINUL D-49	BASF Chemical Co.
	Benzophenone-12	UVINUL 408	BASF Chemical Co.
	4-Isopropyl dibenzoyl methane	EUSOLEX 8020	EM Industries
30	Butyl methoxy dibenzoyl methane	PARSOL 1789	Givaudan Corp.
	Etocrylene	UVINUL N-35	BASF Chemical Co.

The amount of the organic sunscreens in the cosmetic composition is preferably in the range of about 0.1 wt % to about 10 wt %, more preferably about 1 wt % to 5 wt %.

- 5 Preferred organic sunscreens are PARSOL MCX and Parsol 1789, due to their effectiveness and commercial availability.

Perfumes

- 10 Perfumes are fragrance compositions that are mixtures of components providing, usually, a pleasing sense of smell. Terpenes and terpene derivatives are often an important component of fragrances. Fragrance terpenes and derivatives are described in Bauer, K., et al., Common Fragrance and Flavor  
15 Materials, VCH Publishers (1990).

- Terpenes and derivatives that may preferably be incorporated in the inventive cosmetic compositions are divided into three classes, including acyclic terpenoids, cyclic terpenoids, and cycloaliphatic compounds that are structurally  
20 related to terpenoids.

Terpene derivatives within each of the three classes include alcohols, ethers, aldehydes, acetals, acids, ketones, esters, and terpene compounds that contain heteroatoms such as nitrogen or sulfur.

- 25 Examples of terpenes and derivative that may be incorporated in the cosmetic compositions of the present invention are set forth in the tables below:

TABLE 2. Acyclic Terpenes and Derivatives

HYDROCARBONS

- Myrcene  
5 Ocimene  
beta-Farnesene

ALCOHOLS

- 10 Dihydromyrcenol (2,6-dimethyl-7-octen-2-ol)  
Geraniol (3,7-dimethyl-*trans*-2,6-octadien-1-ol)  
Nerol (3,7-dimethyl-*cis*-2,6-octadien-1-ol)  
Linalool (3,7-dimethyl-1,6-octadien-3-ol)  
Myrcenol (2-methyl-6-methylene-7-octen-2-ol)  
15 Lavandulol  
Citronellol (3,7-dimethyl-6-octen-1-ol)  
*Trans-trans*-Farnesol (3,7,11-trimethyl-2,6,10-dodecatrien-1-ol)  
*Trans*-Nerolidol (3,7,11-trimethyl-1,6,10-dodecatrien-3-ol)

20

ALDEHYDES AND ACETALS

- Citral (3,7-dimethyl-2,6-octadien-1-al)  
Citral diethyl acetal (3,7-dimethyl-2,6-octadien-1-al diethyl acetal)  
Citronellal (3,7-dimethyl-6-octen-1-al)  
25 Citronellyloxyacetaldehyde  
2,6,10-Trimethyl-9-undecenal

TABLE 2. Acyclic Terpenes and Derivatives (cont'd)

KETONES

- Tagetone  
5 Solanone  
Geranylacetone (6,10-dimethyl-5,9-undecadien-2-one)

ACIDS AND ESTERS

- 10 *Cis*-Geranic acid  
Citronellic acid  
Geranyl Esters, including Geranyl formate, Geranyl acetate, Geranyl propionate,  
Geranyl isobutyrate, Geranyl isovalerate  
Neryl Esters, including Neryl acetate  
15 Linalyl Esters, including Lynalyl formate, Linalyl acetate, Linalyl propionate,  
Linalyl butyrate, Linalyl isobutyrate,  
Lavandulyl Esters, including Lavendulyl acetate  
Citronellyl Esters, including Citronellyl formate, Citronellyl acetate, Citronellyl  
propionate, Citronellyl isobutyrate, Citronellyl isovalerate, Citronellyl tiglate

20

NITROGEN CONTAINING UNSATURATED TERPENE DERIVATIVES

- Cis*-Geranic acid nitrile  
Citronellic acid nitrile

TABLE 3. Cyclic Terpenes and Derivatives

HYDROCARBONS	
	Limonene (1,8-p-menthadiene)
	Alpha-Terpinene
5	Gamma-Terpinene (1,4-p-menthadiene)
	Terpinolene
	Alpha-Phellandrene (1,5-p-menthadiene)
	Beta-Phellandrene
	Alpha-Pinene (2-pinene)
10	Beta-Pinene (2(10)-pinene)
	Camphene
	3-Carene
	Caryophyllene
	(+)-Valencene
15	Thujopsene
	Alpha-Cedrene
	Beta-Cedrene
	Longifolene
20	ALCOHOLS AND ETHERS
	(+)-Neoiso-isopulegol
	Isopulegol (8-p-menten-3-ol)
	Alpha-Terpineol (1-p-menten-8-ol)
	Beta-Terpineol
25	Gamma-Terpineol
	Delta-Terpineol
	1-Terpinen-4-ol (1-p-menten-4-ol)

TABLE 3. Cyclic Terpenes and Derivatives (cont'd)

ALDEHYDES AND KETONES

	Carvone	(1,8- <i>p</i> -mentadien-6-one)
5	Alpha-Ionone	(C <sub>13</sub> H <sub>20</sub> O)
	Beta-Ionone	(C <sub>13</sub> H <sub>20</sub> O)
	Gamma-Ionone	(C <sub>13</sub> H <sub>20</sub> O)
	Irone, alpha-, beta-, gamma-	(C <sub>14</sub> H <sub>22</sub> O)
	<i>n</i> -Methylionone, alpha-, beta-, gamma-	(C <sub>14</sub> H <sub>22</sub> O)
10	Isomethylionone, alpha-, beta-, gamma-	(C <sub>14</sub> H <sub>22</sub> O)
	Allylionone	(C <sub>16</sub> H <sub>24</sub> O)
	Pseudoionone	
	<i>n</i> -Methylpseudoionone	
	Isomethylpseudoionone	
15		
	Damascones	1-(2,6,6-trimethylcyclohexenyl)-2-buten-1-ones
	Including beta-Damascenone	1-(2,6,6-trimethyl-1,3-cyclohexadienyl)-2-buten-1-one
20	Nootkatone	5,6-dimethyl-8-isopropenylbicyclo[4.4.0]-1-decen-3-one
	Cedryl methyl ketone	(C <sub>17</sub> H <sub>26</sub> O)
25		

ESTERS

30	Alpha-Terpinyl acetate	(1- <i>p</i> -menthen-8-yl acetate)
	Nopyl acetate	(-)-2-(6,6-dimethylbicyclo[3.1.1]hept-2-en-2-yl)ethyl acetate
	Khusymil acetate	

TABLE 4. Cycloaliphatic Compounds Structurally Related to Terpenes

5

ALCOHOLS

5-(2,2,3-Trimethyl-3-cyclopenten-1-yl)-3-methylpentan-2-ol

ALDEHYDES

10 2,4-Dimethyl-3-cyclohexene carboxaldehyde

4-(4-Methyl-3-penten-1-yl)-3-cyclohexene carboxaldehyde

4-(4-Hydroxy-4-methylpentyl)-3-cyclohexene carboxaldehyde

15 KETONES

Civetone

Dihydrojasmone (3-methyl-2-pentyl-2-cyclopenten-1-one)

Cis-Jasmone 3-methyl-2-(2-cis-penten-1-yl)-2-cyclopenten-1-one

20 5-Cyclohexadecen-1-one

2,3,8,8-Tetramethyl-1,2,3,4,5,6,7,8-octahydro-2-naphthalenyl methyl ketone

3-methyl-2-cyclopenten-2-ol-1-one

25 ESTERS

4,7-Methano-3a,4,5,6,7,7a-hexahydro-5-(or 6)-indenyl acetate

Allyl 3-cyclohexylpropionate

Methyl dihydrojasmonate methyl (3-oxo-2-pentylcyclopentyl)acetate

Preferably, the amount of terpenes and derivatives in the cosmetic composition is in the range of about 0.000001 % to about 10 %, more preferably about 0.00001 % to about 5 wt %, most preferably about 0.0001 % to about 2 %.

5

### USE OF THE COMPOSITION

10 The method according to the invention is intended primarily as using a personal care product for topical application to human skin.

In use, a small quantity of the composition, for example from 1 to 5 ml, is applied to exposed areas of the skin, from a suitable container or applicator and, if necessary, it is then spread over and/or rubbed into the skin using the hand or  
15 fingers or a suitable device.

### PRODUCT FORM AND PACKAGING

The cosmetic composition useful for the method of the invention can be  
20 formulated as a lotion having a viscosity of from 4,000 to 10,000 mPa.s, a fluid cream having a viscosity of from 10,000 to 20, 000 mPa.s or a cream having a viscosity of from 20,000 to 100,000 mPa.s, or above. The composition can be packaged in a suitable container to suit its viscosity and intended use by the consumer. For example, a lotion or fluid cream can be packaged in a bottle or a roll-ball applicator or a propellant-driven aerosol device or a container fitted with  
25 a pump suitable for finger operation. When the composition is a cream, it can simply be stored in a non-deformable bottle or squeeze container, such as a

tube or a lidded jar. When the composition is a solid or semi-solid stick, it may be packaged in a suitable container for manually or mechanically pushing out or extruding the composition.

5       The invention accordingly also provides a closed container containing a cosmetically acceptable composition as herein defined.

10      The following examples are by way of example, not by way of limitation, of  
the principles of the present invention, to illustrate the best mode of carrying out  
the invention.

#### EXAMPLE 1

##### Procedure for Making 1,3-dithiane Resorcinol

15

The compound of formula III was prepared in accordance with the process discussed hereinbelow and used throughout the examples that follow:

20

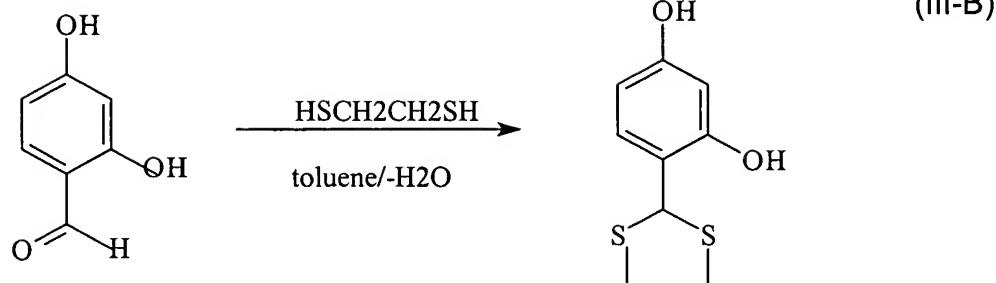


In a most preferred embodiment designated by the compound of formula III, N is zero; each A<sub>1</sub> and A<sub>2</sub> represents H, both Y<sub>1</sub> and Y<sub>2</sub> represent H, because it is most cost-effective to manufacture. This most preferred embodiment, referred to herein as 1,3-dithiane resorcinol, may be prepared by reaction of 2,4-  
5 dihydroxy benzaldehyde and 1,3-Dimercaptoethane (Both starting materials are available from Yick-Vic Chemicals & Pharmaceuticals (HK) Ltd/ Hong Kong), denoted by the following formula III and catalyzed by an acid catalyst. Suitable catalysts include but are not limited to methane sulfonic acid, p-toluene sulfonic acid, H<sub>2</sub>SO<sub>4</sub> (sulfuric acid), HCl (hydrochloric acid) and acidic resins.

10

A three necked flask equipped with a Dean-Stark apparatus , an additional funnel and a condenser is charged with 2, 4- dihydroxy benzaldehyde ( 1 equ.). To this was added toluene ( 500ml) and a catalytic amount of p-toluene sulfonic acid. The mixture was heated at 120 C. One equivalent of 1,3-  
15 dithioethane in toluene (100ml) was added drop-wise to the mixture . The mixture was stirred at reflux up to 12 hours. The solvent was removed on a rotavap and the expected product was isolated. The structure of the dithiane was confirmed using Mass spectroscopy, NMR and IR.

5



10

## EXAMPLE 2

15

Cosmetic compositions within the scope of the invention were prepared.

A base formulation shown in Table 3, below, was made by heating phase A ingredients to 70 to 85° C with stirring. Phase B ingredients were heated in a separate container to 70 to 85° C with stirring. Then, phase A was added into phase B while both phases were kept at 70 to 85° C. The mixture was stirred for at least 15 minutes at 70 to 85° C, then cooled.

A base formulation is shown in the table below.

TABLE 5

<u>Ingredients</u>	<u>a</u> %wt.	<u>b</u> %wt.	<u>Phase</u>
Isostearyl Palmitate	6.00	6.00	A
C12-C15 Alkyl Octanoate	3.00	3.00	A
PEG-100 Stearate	2.00	2.00	A
Glyceryl Hydroxystearate	1.50	1.50	A
Stearyl Alcohol	1.50	1.50	A
Stearic acid	3.00	4.00	A
TEA, 99%	1.20	1.20	B
Dimethicone	1.00	1.00	A
Sorbitan Monostearate	1.00	1.00	A
Magnesium Aluminum Silicate	0.60	0.60	B
Vitamin E acetate	0.10	0.10	A
Cholesterol	0.50	0.50	A
Simethicone	0.01	0.01	B
Xanthan gum	0.20	0.20	B
Hydroxyethylcellulose	0.50	0.50	B
Propylparaben	0.10	0.10	B
Disodium EDTA	0.05	0.05	B
Butylated hydroxytolene	0.05	0.05	B
<i>Compound of Formula III</i>	0.05	2.00	B
Niacinamide	1.00	1.00	B
Metal oxide	2.50	5.00	B
Methylparaben	0.15	0.15	B
Water	<u>BAL</u>	<u>BAL</u>	B
Total	100.00	100.00	B

\*BAL means Balance.

5

EXAMPLE 3

10 Additional cosmetic compositions within the scope of the invention  
were prepared.

TABLE 6

	Wt%	Phase
water, DI	BALANCE	A
disodium EDTA	0.05	A
magnesium aluminum silicate	0.6	A
methyl paraben	0.15	A
simethicone	0.01	A
butylene glycol 1,3	3.0	A
hydroxyethylcellulose	0.5	A
glycerine, USP	2.0	A
xanthan gum	0.2	A
triethanolamine	1.2	B
stearic acid	3.0	B
propyl paraben NF	0.1	B
glyceryl hydroxystearate	1.5	B
stearyl alcohol	1.5	B
isostearyl palmitate	6.0	B
C12-15 alcohols octanoate	3.0	B
dimethicone	1.0	B
cholesterol NF	0.5	B
sorbitan stearate	1.0	B
Micronized titanium dioxide	5.0	C
tocopheryl acetate	0.1	B
PEG-100 stearate	2.0	B
sodium stearoyl lactylate	0.5	B
hydroxycaprylic acid	0.1	C
Compound of Formula III	10.0	C
PARSOL MCX	2.4	C
alpha-bisabolol	0.2	C

The composition of Example 3, was prepared as follows:

1. Heat Phase A to 80°C
2. Heat Phase B to 75°C in a separate container
3. Add B to A and mix with heat off for 30 min.
4. At 50°C add Phase C and mix for 10 min.

5

#### EXAMPLES 4 - 11

A set of additional compositions useful in the methods of the present invention were prepared within the scope of the present invention and are listed  
10 in the table below.

TABLE 7

Ingredients	Phase	Examples (wt. %)								
		4 acid soap base	5	6	7	8	9	10	11	
Stearic acid	A	17.9	17.9	17.9	17.9	17.9	17.9	17.9	17.9	17.9
Sodium cetearyl sulfate* (emulsifier)	A		2.2		1	1.5	2	3	2	
Myrj 59* (emulsifier)	A			2	2	2	2	2	1	
Span 60* (emulsifiers)	A			2	2	2	2	2	1	
Compound of Formula III	B	0.05	0.05	2.0	2.0	3.5	3.5	5.0	10.0	
Micronized Zinc Oxide	B	2.50	5.00	5.00	2.50	2.50	5.00	2.50	5.00	
KOH, 22% (form <i>in situ</i> soap with stearic acid)		2.20								
Octyl methoxycinnamate		2.50			2.50	2.50		2.50		
Water	B	BAL	BAL	BAL	BAL	BAL	BAL	BAL	BAL	
Glycerin	B	1	1	1	1	1	1	1	1	

EXAMPLE 12. Mushroom Tyrosinase Assay

Mushroom tyrosinase inhibition is indicative of reduction in melanin synthesis, thereby showing skin lightening effect. This experiment shows the  
5 efficacy of resorcinol derivatives of the present invention.

Into each well of a 96-well plate, 150 microliters of phosphate buffer (100 mM, pH 7.0), 10 microliters of L-DOPA (L-3, 4-Dihydroxyphenylalanine, 10 mM), and 20 microliters of skin lightening agent (dissolved in ethanol, which is the  
10 control) were added. Following an initial measurement of background absorbency at 475-nm, 20 microliters of mushroom tyrosinase (Sigma T-7755; 6050 units/ml) was added and incubated at room temperature.

Absorbency is read at 475-nm over the following time points: 0, 2, 4, and  
15 6.5 minutes. The data is plotted as 475-nm absorbency vs. time (minutes) and the slope of the line is calculated ( $\Delta$ Abs 475nm/ min). In the Table below, data is shown in terms of IC50, which is the concentration of active needed to reduce tyrosinase synthesis by 50 % versus the untreated ethanol control reaction.

20

TABLE 8. Mushroom Tyrosinase Assay Results

Compound	IC50 (Concentration) Experiment 1	IC50 (Concentration) Experiment 2
4-Ethyl Resorcinol (Positive Control)	550 nano-M	400 nano-M
6-member Di-Thianyl Resorcinol	1.7 micro-M	1.0 micro-M
5-member Di-Thianyl Resorcinol	3.8 micro-M	2.5 micro-M

5

The data show that the inventive compounds are substantially as effective or slightly less effective than 4-ethyl resorcinol, both compounds having good skin lightening effects. An advantage of the inventive compounds is that they are relatively easy and cost-effective to manufacture.

10

It should be understood that the specific forms of the invention herein illustrated and described are intended to be representative only. Changes, including but not limited to those suggested in this specification, may be made in  
15 the illustrated embodiments without departing from the clear teachings of the disclosure. Accordingly, reference should be made to the following appended claims in determining the full scope of the invention.